STATE OF CALIFORNIA

Department of Transportation
[1]Specification #PTWB-01
For

Paint, Waterborne Traffic Line, White, Yellow and Black

1.0 SCOPE This Specification covers a ready-mixed, one–component, waterborne acrylic traffic line paint which can be applied to either asphalt concrete or portland cement concrete pavements.

2.0 SPECIFICATIONS AND STANDARDS The following Specifications, Test Methods, and Standards in effect on the opening date of the Invitation for Bid form a part of this Specification where referenced.

- American Society for Testing and Materials (ASTM) Designations: D65, ASTM D75, ASTM D93, ASTM D476, ASTM D522, ASTM D562, ASTM D711, ASTM D713, ASTM D869, ASTM D1210, ASTM D1475, ASTM D1640, ASTM D1729, ASTM D1849, ASTM D2243, ASTM D2369, ASTM D2486, ASTM D3168, ASTM D3335, ASTM D3718, ASTM D3723, ASTM D3960, ASTM D4563, ASTM D5380, ASTM D6359-98, ASTM D6628-01, ASTM E70, ASTM E313, ASTM E1710-97, ASTM G151 and ASTM G154.
- Federal Specification 595b, Color #33538 and #37038.
- Code of Federal Regulations, Title 49.
- California Code of Regulations, Title 22, Division 4.
- California Department of Transportation, Test Method No. 660.
- California Department of Transportation, Standard Specifications, July, 1999.

3.0 REQUIREMENTS

3.1 General: This Specification is intended to specify traffic paint that will meet pavement delineation requirements for highway construction and maintenance. This traffic paint is to be used in conjunction with glass spheres to produce pavement delineation that is visible during both day and night conditions.

3.2 Composition:

---

[1] Note: This Specification cancels and supersedes; #PTWB-01 (September, 2002), #PTWB-01 (September, 2001), #8010-20B (January, 2000), #8010-20A (February, 1997), #8010-20 (March, 1996), #8010-03QPL (October, 1994), #8010-21C-30 (March, 1992), and #8010-91D-30A (April, 1989).

3.2.1 Acrylic Polymer Emulsion

The paint binder shall consist of one of the commercial acrylic polymer emulsions described below;

- Rohm & Haas Rhoplex Fastrack HD-21A Emulsion
- Rohm & Haas Rhoplex Fastrack 3427 Emulsion
- Dow Chemical DT-400NA Emulsion
- Dow Chemical DT-250NA Emulsion

3.2.2 Prime Pigments

White paint:

The white paint shall contain a minimum of 0.12 kg per liter of titanium dioxide pigment meeting ASTM D476 Type II (Rutile). The titanium dioxide content will be determined using ASTM Designations; D 4563 and D 5380.

Yellow paint:

The yellow paint shall be pigmented with Pigment Yellow C.I. #65 and/or Pigment Yellow C.I. #75. Other pigments may be added to meet the yellow color and opacity requirements in sections; 3.3.19 and 3.3.16, respectively. However, the paint shall not contain lead or chroumium at levels above the limits set in sections; 3.3.23 and 3.3.24.

3.2.3 The remainder of the paint composition shall be determined by the manufacturer - within the constraints of the requirements below. It shall be the manufacturer's responsibility to produce a pigmented waterborne traffic paint containing the necessary; co-solvents, dispersants, preservatives, wetting agents and all other additives - so that the paint will retain its viscosity, stability and all other properties as specified herein. No glass beads or sand shall be permitted in the paint formulations. In addition to being essentially lead and chromium free, the paint shall not contain any hazardous materials at levels that would cause the paint (when dry) to be classified as a hazardous waste under Title 22, Division 4, section 66261.20 of the California Code of Regulations.

3.3 Characteristics of the Finished Paint:

3.3.1 Condition in the Container

The paint, as received, shall show no evidence of; biological growth, corrosion of the container, livering or hard settling. The paint shall be returned to a smooth and homogeneous consistency, which is free from; gel structures, persistent foam or air bubbles - using only hand mixing.

	White	Yellow	Black
3.3.2 Degree of Settling, minimum, ASTM D869	7	7	7

A 500 ml (1 pint) paint can is filled with a well mixed sample. The can is capped and allowed to set undisturbed at [2]standard conditions for 14 days. The settling is then determined as specified in ASTM D869. The 1-quart laboratory samples of each batch, as received, shall also pass this test.

		White	Yellow	Black
3.3.3	Nonvolatile Content, Weight %, ASTM D2369	77 ±2.0	76 ±2.0	76 ±2.0

		White	Yellow	Black
3.3.4	Pigment Content, Weight %, ASTM D3723	60 ±2.0	58 ±2.0	58 ±2.0

		White	Yellow	Black
3.3.5	% Nonvolatile in Vehicle (%NVV), Weight %, minimum Calculated as;	42	42	42

$$\% \text{ NVV} = \frac{\%\text{Nonvolatile Content} - \%\text{ Pigment}}{100 - \%\text{ Pigment}} \times 100$$

		White	Yellow	Black
3.3.6	Density, g/ml at 25°C, ASTM D1475	1.68 ±0.04	1.63 ±0.04	1.62 ±0.04

		White	Yellow	Black
3.3.7	Consistency, K.U. at 25 ±1°C ASTM D562	78-92	78-92	78-90

		White	Yellow	Black
3.3.8	Fineness of Dispersion, Hegman, minimum, ASTM D1210	3.0	3.0	3.0

		White	Yellow	Black
3.3.9	Dry to No Pick-Up Time, without beads, minutes, maximum, ASTM D711	10	10	10

		White	Yellow	Black
3.3.10	Dry Through, minutes, maximum	20	20	20

This test may be performed on the same draw down sample as in section 3.3.9. The test is the same as outlined in ASTM D1640 except that the lightest thumb pressure possible should be used. The thumb is rotated through an angle of 90 degrees while lightly in contact with the film. The drying time at which this rotation does not break the film is recorded.

		White	Yellow	Black
3.3.11	Dry Through, at 90% Relative Humidity,	180	180	-

[2] Standard conditions are defined here as: 23±2°C and 50±5% relative humidity.

minutes, maximum

Draw down the paint on a glass panel to a wet film thickness of 330µm. Immediately place the panel in a humidity chamber maintained at 23±2°C and 90±5% Relative Humidity. Test in accordance with ASTM D1640 except that the pressure exerted shall be the minimum needed to maintain contact between the thumb and the paint film. Check the film for a dry through condition at 15 minute intervals. The thumb is rotated through an angle of 90 degrees while lightly in contact with the film. The drying time at which this rotation does not break the film is recorded. Quickly return the glass panel to the humidity chamber after each check.

	White	Yellow	Black
3.3.12 Volatile Organic Compounds (VOC), grams per liter of paint, excluding water, maximum.	150	150	150

Use ASTM D3960 or other approved method in effect at the time of paint manufacture to determine the VOC level and water content of the paint.

	White	Yellow	Black
3.3.13 Flashpoint, °C , minimum, ASTM D93 Method A	38	38	38

	White	Yellow	Black
3.3.14 Flexibility, ASTM D522 Method B	Pass	Pass	Pass

Use 100x150 mm tin-plated steel panels 250µm thick. Prepare the panel by lightly buffing one side with Grade 0 (medium-fine) steel wool, followed by cleaning with toluene and drying. Draw down the paint on the buffed side of the panel to a wet film thickness of 130µm. Air dry the panel for 24 hours at standard conditions, then bake for 5 hours at 105±2°C and finally condition the panel for 30 minutes at standard conditions. Bend the panel 180° over a 13 mm mandrel in 1 second, then examine under a magnification of 10 diameters. The paint film shall not; crack, chip or flake when the panel is bent around the mandrel.

	White	Yellow	Black
3.3.15 Appearance	Pass	Pass	Pass

Draw down a 330µm thick wet film of the paint on a glass plate and allow to dry for 24 hours at standard conditions. The paint shall produce a film which is smooth, uniform, and free from; grit, undispersed particles, craters, pinholes and cracking.

	White	Yellow	Black
3.3.16 Dry Opacity, minimum	0.93	0.87	1.0

On a black-white Leneta chart, Form 2C-Opacity, draw down a uniform 130µm (± 5µm) thick wet film of paint covering both the black and white portions of the chart. Measure the wet

film thickness with an appropriate gauge. Dry for 24 hours at standard conditions. Use a BYK-Gardner "Color-Guide" Spectrophotometer to measure the opacity according to the manufacturer's instructions. Calibrate the spectrophotometer according to the manufacturer's instructions using; 2° Observer/Illuminant "C" measurement conditions, and the (Y, x, y) color system.

	White	Yellow	Black
3.3.17 Yellowness Index, maximum	8	-	-

Draw down a 330µm thick wet film of the white paint on two 75x150 mm chromate treated aluminum panels (i.e.: Q Panel Co., type AL). Dry for 24 hours at standard conditions. Save one panel for the Accelerated Weathering test (section 3.3.21). Using a BYK-Gardner "Color-Guide" Spectrophotometer, follow the manufacturer's instructions (see section 3.3.16), and measure the Yellowness Index of the white paint film using the ASTM E313 mode.

	White	Yellow	Black
3.3.18 Daylight Luminous Reflectance	≥87	47-60	≤4

Using the draw down panels prepared in sections 3.3.17 or 3.3.19, measure the reflectance of the white and yellow paint films using the BYK-Gardner "Color-Guide" Spectrophotometer. Follow the manufacturer's instructions to obtain the Reflectance or "Y" value (see section 3.3.19).

3.3.19 Yellow Color

Draw down the yellow paint on two chromate treated aluminum panels as described in section 3.3.17. One panel should be used for the Accelerated Weathering test (section 3.3.21). Retain the other yellow panel as a control and for the Reflectance test (section 3.3.18). The yellow color shall match Federal Standard 595b, color #33538 and shall lie within the "box" formed by the chromaticity coordinate limits as defined below, when tested according to California Test Method No. 660 and plotted on a C.I.E. (1931) Chromaticity Diagram. A BYK-Gardner "Color-Guide" spectrophotometer, that has been set up as described below, can also be used to measure the chromaticity coordinates. The measured yellow color shall lie within the "box" formed by the chromaticity coordinate limits - both before and after the Accelerated Weathering test (see section 3.3.21). A graph for plotting the chromaticity coordinates is available from the Transportation Laboratory.

Color System: C.I.E. (1931) Chromaticity Diagram, (Y, x, y)
Measurement conditions: 2º Observer / Illuminant "C"
Hue: 580 to 583.5 nm
Minimum color saturation: x=0.7000-0.5000y
Brightness: Y=47 to 60

The yellow color coordinates shall lie within a "box" defined by plotting the following four (x,y) pairs on the C.I.E. Chromaticity Diagram (1931).

(x1,y1) = (0.5125, 0.4866)

(x2,y2) = (0.4733, 0.4533)
(x3,y3) = (0.4848, 0.4305)
(x4,y4) = (0.5348, 0.4646)

3.3.20 Black Color

Draw down the black paint on a chromate treated aluminum panel as described in section 3.3.17. After drying for 24 hours at standard conditions the color shall closely match Federal Standard 595b, color #37038. The black paint must also meet the Daylight Luminous Reflectance requirement in section 3.3.18.

3.3.21 Accelerated Weathering Test
Ultraviolet Light and Condensate Exposure, 300 hours total, ASTM; G154 and G151.

Prepare samples of the white and yellow paints as described in sections 3.3.17 and 3.3.19. Alternately expose the samples to; eight hours of UV exposure at 60°C, followed by four hours condensate exposure at 50°C - in a QUV Accelerated Weathering Tester. Type UVA-340 bulbs are used at an irradiance level of 0.77 watts per square meter per nm. at 340 nm., as measured at the sample surface during the UV cycle. After 300 hours total exposure the paint samples shall meet the requirements below.

White - Yellowness Index after weathering, maximum, 12 (see section 3.3.17)
Yellow - Must pass Yellow Color test after weathering (see section 3.3.19)

	White	Yellow	Black
3.3.22 Scrub Resistance, cycles, minimum	800	800	-

Follow the procedure in ASTM D2486. Prepare a panel using an appropriate bird doctor blade that will produce a uniform dry film thickness of paint between 80 and 100µm. Dry the panel for 7 days at standard conditions. The panel shall require more than 800 cycles to remove the paint film in one continuous line across the width of the shimmed area.

	White	Yellow	Black
3.3.23 Lead, mg/kg in dried paint, maximum, ASTM D3335	20	20	20

	White	Yellow	Black
3.3.24 Chromium, mg/kg in dried paint, maximum, ASTM D3718	5	5	5

	White	Yellow	Black
3.3.25 Thick Application Cracking Resistance	Pass	Pass	Pass

On a black-white Leneta chart, Form 2C-Opacity, draw down a stripe of the paint 75 mm wide and at least 150 mm long and having a 1530±130µm wet film thickness. Allow the paint to dry for 48 hrs. at standard conditions on a horizontal surface. After 48 hrs. the paint film shall not contain any cracks.

	White	Yellow	Black
3.3.26 Accelerated Package Stability	Pass	Pass	Pass

Fill a clean 500 mL (1 pint) resin-lined, friction-top paint can with a well-stirred sample. Measure the initial Consistency as in section 3.3.7. Close the can tightly. Store this can in an oven at a temperature of 52ºC for 14 days. After 14 days remove the can from the oven and allow the can to cool overnight. Determine the Consistency of the paint as in section 3.3.7, except allow hand stirring of the sample for 5 minutes to ensure uniform redistribution of any settlement before testing. The Consistency of the paint shall not change more than 7 K.U. after this heated storage period – when compared to the initial Consistency. Draw down a 330µm thick wet film of this sample on a glass plate and examine for Appearance as in 3.3.15.

	White	Yellow	Black
3.3.27 Infrared Spectra of Nonvolatile Vehicle, allowable variation from laboratory reference spectra, ASTM D3168	None	None	None

	White	Yellow	Black
3.3.28 pH, ASTM E70	10 ±1.0	10 ±1.0	10 ±1.0

	White	Yellow	Black
3.3.29 Initial Retroreflectivity of Applied Paint (with beads), $mcd \bullet m^{-2} \bullet lx^{-1}$, minimum	250	175	-

The paint shall produce delineation that has the minimum required level of retroreflectivity when applied to pavement (with drop-on beads) according to the manufacturer's recommendations. Drop-on glass beads shall be uniformly applied at a minimum rate of 0.6-kg per liter of paint. The retroreflectivity shall be measured as specified in ASTM D6359-98 using a retroreflectometer meeting ASTM E1710-97.

3.3.30 Color after Application

The color of the applied white and yellow stripes and markings (with beads) shall conform to the daytime and nighttime color requirements in ASTM Designation: D 6628-01.

3.4 Workmanship, Settling and Shelf-Life:

3.4.1 The paint shall be free from foreign materials such as; dirt, sand, fibers, or other materials capable of clogging; screens, valves, pumps, or other equipment used in paint striping apparatus.

3.4.2 The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container and shall not become granular or curdled. Any settlement of the pigment in the paint shall result in a thoroughly wetted soft mass that permits the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with a minimum of resistance to the sidewise manual motion of the paddle across the bottom of the

container. This stirring shall return the paint to a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement or any other cause, then the paint shall be considered unfit for use.

3.4.3 The paint shall retain all specified properties under normal storage conditions for 8 months after acceptance and delivery. Ordered paint shall be no more than 90 days old (based on date of manufacture) upon delivery to a Department of Transportation Maintenance facility. The date of manufacture shall be clearly marked on each container. The vendor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The characteristics of any replacement paint, as specified in section 3.3, shall remain satisfactory for 8 months from the date of acceptance and delivery.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Sampling and Testing: A one-quart representative sample of each batch of traffic paint intended for use by the Department of Transportation must be sent to the Transportation Laboratory for testing and approval **before** the batch is shipped. The address of the Transportation Laboratory is listed in section 6.4. A batch shall be that amount of paint which was manufactured and packaged in a single operation. Contact the nearest Department of Transportation Inspection Office (see section 6.4) to have the samples tagged prior to sending the samples to the Transportation Laboratory for testing. The Department of Transportation reserves the right to take random samples of batches of paint destined for use by the Department, at the manufacturer's facility. If requested by the Inspector, batch tickets must also be provided for batches of paint produced for the Department.

A manufacturer's test report shall be included with the one-quart sample of each batch sent to the Transportation Laboratory. The following information shall be included in the manufacturer's test report:

- State Specification number (#PTWB-01 (December 2003)).
- Batch number, batch volume, color, date of manufacture.
- Dry to No Pick-Up time (section 3.3.9).
- Dry Opacity (section 3.3.16).
- Yellowness Index (of white only, see section 3.3.17).
- Reflectance (section 3.3.18).
- Yellow Color (of yellow only, see section 3.3.19).
- Consistency (sectioon 3.3.7).
- Nonvolatile Content, Weight Percent (section 3.3.3).
- Pigment, Weight Percent (section 3.3.4).
- Density (section 3.3.6).

Once the Transportation Laboratory approves a batch of paint, the manufacturer will be notified that the batch is approved for shipment. Upon shipment of the approved batch of paint, the manufacturer shall fax the following information to the Transportation Laboratory within 48 hours.

- A list of each delivery location.
- Name and phone number of contact person(s) at the delivery location(s).
- State Specification number (#PTWB-01).
- Colors, batch numbers and quantity of each batch of paint delivered.

This information shall be faxed to: Transportation Laboratory, Chemical Testing Section, 5900 Folsom Blvd., Sacramento, CA 95819-0128, attn.: Lisa Dobeck, Fax (916) 227-7168.

The Department of Transportation reserves the right to retest any batch of traffic paint after delivery. Data from such retesting shall prevail over all other tests and will be the basis of rejection. Material not meeting the specification shall be removed and replaced by the supplier at their expense, including all costs for handling, retesting and shipping.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging: All manufactured paint shall be prepared at the factory ready for application. The finished paint shall be furnished in the container size specified in the purchase order or contract.

- When 19 liter (5-gal.) containers are specified, they shall be round and have standard full open head and bail.
- If 208 liter (55-gal.) steel drums are specified, they must have removable lids and airtight band fasteners.
- When 946 liter (250-gal.) bulk containers are specified, they shall be an industry standard type bulk paint container.
- When 1325 liter (350-gal.) bulk containers are required by the purchase order or contract, the paint shall be delivered in a container (tote) meeting the following requirements.

1. Tank volumes are estimated and so specified in each of three (3) Bulk Container drawings dated 09-04-91. Vendor shall allow a 19 liter headspace for expansion of the paint.
2. Maximum size in regards to width, depth and height shall be in accordance with one of the three drawings dated 09-04-91.
3. Top openings; 46 cm diameter manhole and 15 cm diameter fill cap.
4. Bottom outlet; 5 cm I.D. full flow non-restrictive valve with outlet guard.
5. Outlet to have 'Ever-Tite' or compatible quick coupler.
6. Fabricated from 304 stainless steel.
7. Capable of being stacked two (2) high when full.
8. Capable of being lifted by crane (lifting eye) and forklift when full.
9. Top of tank shall be equipped with one (1) vacuum relief valve and one (1) pressure relief valve.
10. Top opening and outlet shall provide for easy installation of liner.
11. Proper certification by the California Highway Patrol that the container complies with all applicable laws, rules, and regulations.

All shipping containers must comply with Code of Federal Regulations, Title 49 and all other applicable Federal and State Regulations governing their use. The containers and lids must be lined with a suitable coating so as to prevent attack by the paint or by agents in the airspace above the paint. The lining must not come off the container or lid as skins. Lids with bungholes shall not be used.

Containers shall be colored white, including lids, and have an identifying band of the appropriate color around and within the top one-third of the container. Stainless steel containers (totes) do not need to be painted white.

All containers shall be properly sealed with suitable gaskets and shall show no evidence of leakage and shall remain in satisfactory condition for a period of 12 months after delivery. The vendor shall be held responsible for replacing containers unfit for use and will be responsible for all costs and transportation charges incurred in replacing paint and containers.

All containers shall be palletized and banded for shipment.

5.2 Marking: All containers of paint shall be labeled showing the State Specification number (PTWB-01), manufacturer's name, date of manufacture, color and manufacturers batch number. Containers shall be clearly labeled "Waterborne Traffic Paint".

All containers of the paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of California.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are; toxic, corrosive, flammable, etc., as outlined in the Code of Federal Regulations, Title 49.

The Contractor shall list on the Demountable Weight Tags the kilograms per liter and pounds per gallon each for the white, yellow and black paints.

6.0 NOTES

6.1 Certification of Compliance: The manufacturer shall furnish a Certificate of Compliance with each batch of paint, in accordance with the provisions of Section 6-1.07 of the Department of Transportation Standard Specifications, July, 1999. This Certificate must state that the particular batch of paint complies with State Specification #PTWB-01.

6.2 Material Safety Data Sheets: The manufacturer shall furnish MSDS product information sheets whenever paint is delivered to a Department of Transportation facility.

6.3 Air Pollution Compliance: The paint shall comply with all air pollution control rules and regulations within the State of California in effect at the time the paint is manufactured.

6.4 Contact Information: Please call the nearest California Department of Transportation Inspection Office (see below) to submit samples for testing. Once samples are tagged by an Inspector, they should be sent to:

California Department of Transportation

Transportation Laboratory – Chemistry Section
5900 Folsom Blvd.
Sacramento, CA 95819
Attention: Andy Rogerson

To arrange for samples to be tagged by an Inspector, contact one of the Inspection Offices below;

LA Area Quality Assurance and Source Inspection
12501 East Imperial Highway – 4th Floor
Norwalk, CA 90650-3136
Phone: (562) 863-0303 or (562) 863-2553
Fax: (562) 863-3308

Bay Area Quality Assurance and Source Inspection
4240 Hollis Street, Suite 300
Emeryville, CA 94608
Phone: (510) 450-7765
Fax: (510) 601-5337

Northern California Quality Assurance and Source Inspection
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, CA 95819
Phone: (916) 227-7258
Fax: (916) 227-7117

Fresno Quality Assurance and Source Inspection
2510 S. East Street. Suite 400
Fresno, CA 93706
Phone: (559) 445-6310
Fax: (559) 488-4343 or (559) 488-4165